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A Revision of the Oribatid Mites of Japan

IV. The Families Archeonothridae,
Palaeacaridae and Ctenacaridae

With 4 Text-figures

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ABSTRACT Descriptions are given to the four species belonging to the primitive oribatid families, Archeonothridae, Palaeacaridae and Ctenacaridae. They are *Zachvatkinella nipponica* sp. nov., *Palaeacarus hystricinus japonicus* subsp. nov., *Palaeacaroides pacificus* Lange and *Ctenacarus araneola* (Grandjean).

The primitive oribatid group “Bifemorata” has been insufficiently studied in Japan. *Palaeacarus hystricinus* Trägårdh is the only species described with figure (Aoki, 1975). A species of the genus *Zachvatkinella* and *Ctenacarus araneola* (Grandjean) were reported from Japan, but with neither description nor figure. In the present paper I re-examined the three species mentioned above and two of them are described here as a new species and a new subspecies, respectively. In addition to them, *Palaeacaroides pacificus* Lange is newly recorded from Japan.

Family Archeonothridae Grandjean, 1932

[Genshi-sasaradani Ka]

Diagnosis. 1) A flame-like false lamella exists on the posterior part of prodorsum; on this false lamella a pair of interlamellar setae inserted. 2) Notogastral setae c_1 and c_2 inserted on a single median sclerite. 3) Seventeen pairs of gastro-notal setae. 4) Palpal tarsus large, rounded, with 16–19 setae, of which 9 are eupathidia. 5) Famulus on tarsus I long.

Elementary chaetotaxy. ntg: (17+17); g: (9+9); ag: (2+2) or (3+3); an: (3+3); ad: (4+4).

Distribution. South Africa, Tristant da Cunha, Siberia, USSR, Himalaya, Japan, South America and Subantarctic Islands.

KEY TO THE GENERA OF THE FAMILY ARCHEONOTHRIDAE

1. Aggenital plates with 3 pairs of setae.....
.....*Zachvatkinella* Lange, 1954(= *Himalacarus* Sheals, 1965)
- Aggenital plates with 2 pairs of setae.....2
2. Long dorsal setae smooth.....*Stomacarus* Grandjean, 1952
- Long dorsal setae barbed.....3
3. Median post-anal sclerite present.....*Archeonothrus* Trägårdh, 1906
- Median post-anal sclerite absent.....*Andacarus* Grandjean, 1958

Genus *Zachvatkinella* Lange, 1954

[Usuiro-debadani Zoku]

Zachvatkinella Lange, 1954, p. 1042, figs. 1–14; Bulanova-Zachvatkina, *et al.*, 1975, p. 47.*Himalacarus* Sheals, 1965, p. 3, figs. 1–10.

Diagnosis. 1) Seta ps_2 sword-like or spear-like, being distinctly thicker than the remaining setae of ps -series. 2) Aggenital plates with 3 pairs of setae. 3) Long dorsal setae barbed.

Elementary chaetotaxy. ntg: (17+17); g: (9+9); ag: (3+3); an: (3+3); ad: (4+4).

Type-species. *Zachvatkinella belbiformis* Lange, 1954.

Distribution. USSR and Japan.

Remarks. It is obvious that Sheals (1965) erected his genus *Himalacarus* without seeing the description of the genus *Zachvatkinella* Lange, 1954. Both the genera are no doubt identical and the former was regarded as a junior synonym of the latter by Bulanova-Zachvatkina *et al.* (1975).

KEY TO THE SPECIES OF THE GENUS *Zachvatkinella*

1. Seta ps_2 dagger-like, thick, ratio of the length to the greatest width being 5.5–5.8.....*Z. belbiformis* Lange, 1954
 - Seta ps_2 spear-like, comparatively slender, ratio of the length to the greatest width being 7.3–10.3.....2
 2. Seta ps_2 weakly constricted in a sub-apical portion3
 - Seta ps_2 not constricted, having straight margins4
 3. Seta f_2 about $1/3$ as long as e_1*Z. doryura* Lange, 1972
 - Seta f_2 about $1/2$ as long as e_1*Z. nipponica* sp. nov.
 4. Seta e_2 as long as f_2 ; ps_2 sharply attenuate toward the tip.....
.....*Z. caucasica* Lange, 1972
 - Seta e_2 distinctly shorter than f_2 ; ps_2 slightly attenuate toward the tip.....
.....*Z. baicalica* Lange, 1972
- Zachvatkinella chimalae* (Sheals, 1965) seems to be identical with *Z. belbiformis* Lange, 1954, having dagger-like seta ps_2 . The identity is, however, still question-

able because the relation in length of setae f_2 and e_1 is unknown.

Zachvatkinella nipponica sp. n.

[Usuiro-debadani]

(Fig. 1)

Diagnosis. 1) Seta ps_2 weakly constricted sub-apically. 2) Seta f_2 a half as long as e_1 . 3) Seta e_2 as long as f_2 .

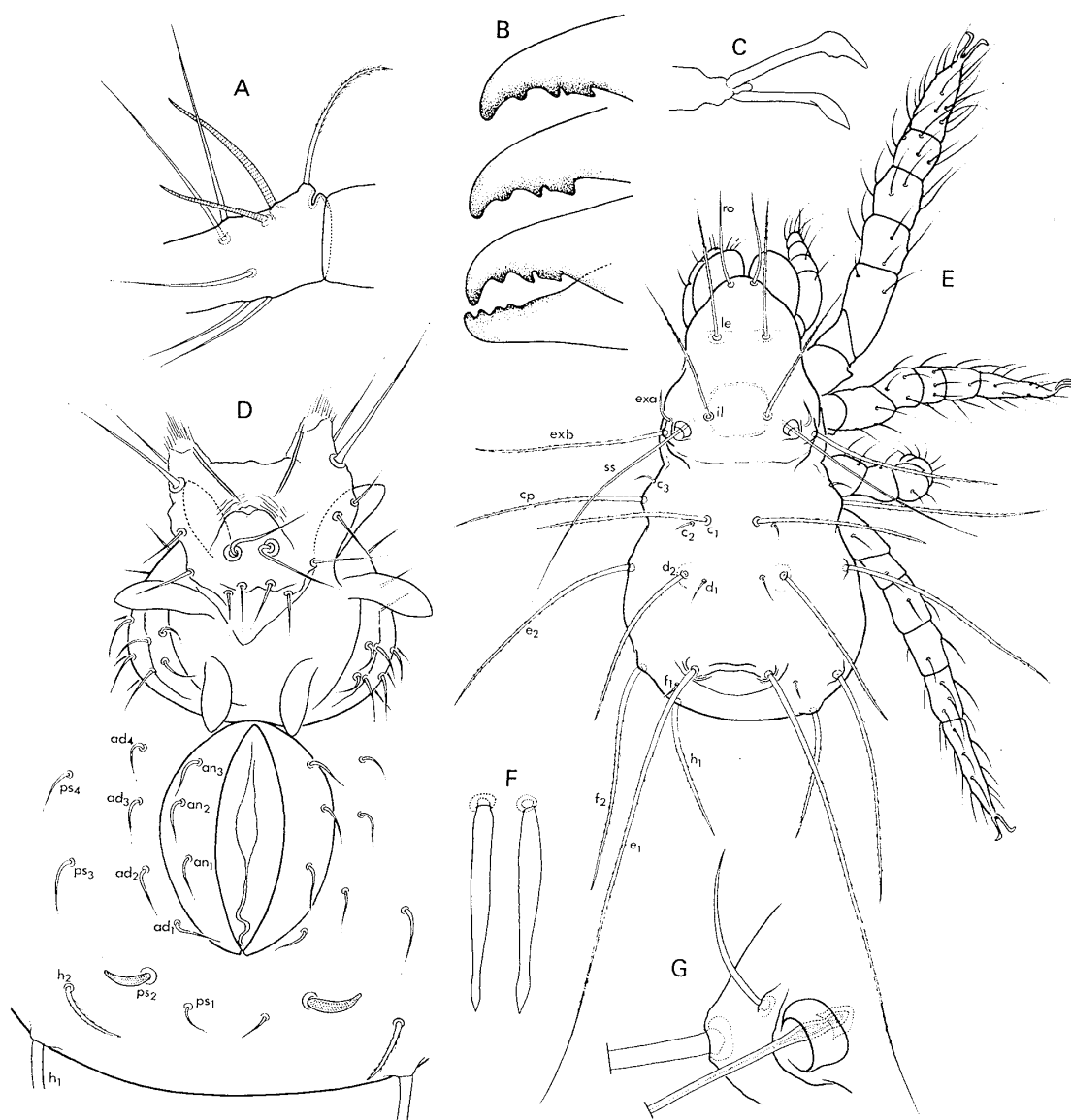


Fig. 1. *Zachvatkinella nipponica* sp. nov. — A: Proximal part of tarsus I. B: Teeth of chelicerae mainly on the fixed digits. C: Claws. D: Ventral side of opisthosoma. E: Dorsal. F: Setae ps_2 . G: Bothridium and its vicinity.

Measurement. Body length: 360–390 μ ; width: 215–220 μ .

Elementary chaetotaxy. ntg: (17+17); g: (9+9); ag: (3+3); an: (3+3); ad: (4+4).

Description. Aspidosoma: Rostral seta nearly smooth. Lamellar seta sparsely barbed, $1.3\text{--}1.4\times$ as long as *ro*. Interlamellar seta also sparsely barbed, about $1.2\times$ as long as *le*. Ratio of each pair of setae to their mutual distance is as follows: $ro/ro-ro=3.8\text{--}4.4$, $le/le-le=2.8\text{--}2.9$, $il/il-il=3.1$. Anterior exobothridial seta short, smooth and curved, being $1/6$ as long as posterior exobothridial seta, which is long (a little longer than *il*) and sparsely barbed. Sensillus smooth, distinctly thinner than *exa*; its basal portion inside bothridium somewhat swollen. False lamella frame-like, rounded quadrate in shape. Opisthosoma: Gastronotal setae consist of three different types; setae c_1 , c_p , d_2 , e_1 , e_2 , f_2 , h_1 and h_2 are of the first type, being long, thick, barbed and dark in color; the order in length of these setae: $e_1 > f_2 > e_2 > c_p > d_2 > c_1 > h_1 > h_2$; seta f_2 a half as long as e_1 ; the longest setae (e_1) longer than body. Setae c_2 , c_3 , d_1 , f_1 , ps_1 , ps_3 and ps_4 are of the second type, being short and smooth. Seta ps_2 of the third type, short and thick, being shaped as a head of spear and weakly constricted in a sub-apical portion. Genito-anal region: Genital plate with 9 setae, of which only 2 seem to have median position, while the remaining setae have lateral position. Aggenital plate with 3 setae. Three anal setae inserted closer to lateral than to median margin of anal plate; an_1 , an_2 and an_3 located nearly on the same level of ad_2 , ad_3 and ad_4 , respectively. Legs: Solenidion ω_1 on tarsus I erect, weakly bending forward and toward anti-axial side (Fig. 1-A). Famulus long, densely barbed and curved distally toward the basal direction. Chelicera. Excepting apical tooth, fixed digit of chelicera provided with 3 teeth, the anterior rounded one, the middle triangular one and the posterior rectangular one (Fig. 1-B).

Type-series. Holotype (NSMT-Ac 9075, in spirit): Kamahara in S of Mihara, Tsumagoi-mura, Gumma-ken, 23-X-1967, J. Aoki, from litter under a deciduous forest (JA 793). Paratypes: 1 ex., Sasago, Otsuki-shi, Yamanashi-ken, 7-XII-1976, J. Aoki & H. Harada, from litter under *Pinus densiflora* (QM 221); 2 exs., same as above, but from litter under *Miscanthus sinensis* (QM 218); 1 ex., Near Hikage tunnel, Katsunuma-shi, Yamanashi-ken, 7-XII-1976, J. Aoki & H. Harada, from surface soil under *Quercus serrata* (JA 2296).

Distribution. Japan (Gumma-ken and Yamanashi-ken).

Remarks. The present new species is very similar to *Z. belbiformis* Lange, 1954, from USSR. Seta f_2 is $1/2$ as long as e_1 , showing the specific feature of *Z. belbiformis*. However, the shape of seta ps_2 is rather similar to that of *Z. doryura* Lange, 1972. Solenidion ω_1 on tarsus I is not decumbent as that of *Z. doryura*, but is erect and only slightly bending. The number and shape of teeth on the fixed digit of chelicera seem to be characteristic of the present new species.

The following species hitherto recorded from Japan are all considered to be the present new species — *Zachvatkinella belbiformes* from Mt. Tanigawa (Shiba,

Aoki and Ishikawa, 1978, p. 117), from Nashigahara of Mt. Fuji (Aoki, Ishikawa, Shiba and Harada, 1978, p. 146) and from Oki Island (Harada and Aoki, 1978, p. 161). — *Zachvatkinell* sp. from Mitsutoge (Fujita, Nishide and Aoki, 1976, p. 28) and from Tokyo (Aoki, Ishikawa and Shiba, p. 99).

Family Palaeacaridae Grandjean, 1932

[Mukashi-sasaradani Ka]

Diagnosis. 1) Opisthosomal setae contain 3–4 pairs of dark, densely barbed setae. 2) Seta c_2 longer than, or as long as, c_1 , being never distinctly shorter than c_1 . 3) Asthenic zone well developed.

Elementary chaetotaxy. ntg: (17+17); g: (9+9); ag: (3+3); an: (4+4); ad: (5+5). Bidactyle.

Distribution. Sweden, England, USSR, Germany, N. America and Japan.

KEY TO THE GENERA OF THE FAMILY PALAEACARIDAE

1. Of the opisthosomal setae, 3 pairs are strong, dark-colored and densely barbed; setae c_1 and c_2 subequal in length; adanal seta ad_2 more than $3\times$ as long as ad_1 .
..... *Palaeacaroides* Lange, 1972
- Of the opisthosomal setae, 4 pairs are strong, dark-colored and densely barbed; seta c_1 distinctly shorter than c_2 ; adanal seta ad_2 less than $2\times$ as long as ad_1 .
..... *Palaeacarus* Trägårdh, 1932

Genus *Palaeacarus* Trägårdh, 1932

[Mukashi-sasaradani Zoku]

Palaeacarus Trägårdh, 1932, p. 2; Bulanova-Zachvatkina *et al.*, 1975, p. 42; Aoki, 1977, p. 184.
Tragardhacarus Zachvatkin, 1945, p. 673.

Diagnosis. 1) Seta c_1 distinctly shorter than c_2 . 2) Of the opisthosomal setae, 4 pairs are strong, dark-colored and densely barbed. 3) Adanal seta ad_2 somewhat longer than the remaining adanal setae, but never exceeding twice the length of ad_1 .

Elementary chaetotaxy. ntg: (17+17); g: (9+9); ag: (3+3); an: (4+4); ad: (5+5). Bidactyle.

Type-species. *Palaeacarus hystericinus* Trägårdh, 1932.

Distribution. Sweden, England, Germany, USSR, N. America and Japan.

Remarks. Bulanova-Zachvatkina *et al.* (1975) recognized 3 species in the genus *Palaeacarus*. All these species are, however, dealt here as the subspecies of *P. hystericinus*.

Palaeacarus hystricinus japonicus subsp. nov.

[Mukashi-sasaradani]

(Fig. 2)

Palaeacarus hystricinus: Aoki, 1975, p. 58, fig. 5; 1977, p. 184.

Diagnosis. 1) Seta h_1 slightly swollen at the middle portion. 2) Famulus on tarsus I weakly curved at tip toward the posterior direction. 3) Palpal tarsus bearing 12 setae and 1 solenidion, of which seta *acm* is trifurcate and *ul'* as well as *sx* bifurcate.

Measurement. Body length: 280 (326) 380 μ ; width: 140 (176) 210 μ .

Elementary chaetotaxy. ntg: (16+16); g: (9+9); ag: (3+3); an: (4+4); ad: (5+5). Palp (solenidia included): 0-2-1-2-12. Epimerata: 4-3-4-4. Bidactyle.

Description. Aspidosoma: Rostral setae more than twice as long as their mutual distance. Lamellar setae somewhat longer than *ro*, shorter than twice the length of their mutual distance. Interlamellar setae very long and whip-like, being subequal in length to sensilli. Anterior exobothridial seta (*exa*) as long as *le* and $3\times$ as long as posterior exobothridial seta (*exp*). Opisthosoma: Seventeen pair of setae are present on opisthosoma excepting genito-anal region; setae d_2 , e_1 , h_2 and ps_2 thick, long, dark-colored and densely barbed except for apical portion (all the remaining setae are glabrous); d_2 and e_1 longer than h_2 and ps_2 ; setae c_2 , e_2 , f_1 , f_2 , h_3 and ps_3 comparatively long, but shorter than opisthosoma; c_1 a half as long as c_2 ; c_p about 1/3 the length of c_2 ; c_3 1/3 as long as c_p ; setae h_1 and ps_1 short and thick, weakly swollen at the middle portion, being inserted very close to h_2 and ps_2 , respectively. Genito-anal region: Genital opening longer than wide, each plate bearing 9 setae. Aggenital plate narrow, of equal width throughout its length, being provided with 3 setae on its posterior half. Anal plate with 4 setae and adanal plate with 5 setae; ad_2 the longest of them, being $1.6-1.8\times$ as long as ad_1 , but not exceeding twice the length of ad_1 .

Type-series. Holotype (NSMT-Ac 9077, on slide): Kawaba-Yuhara at the southern slope of Mt. Hotaka, Gumma-ken, 31-I-1971, J. Aoki, from litter of deciduous trees (JA 1358). Paratopotypes: 4 exs., the same data as holotype. Paratypes: 3 exs., Akanuma in Senjogahara, Nikko, Tochigi-ken, 8-VIII-1961, J. Aoki, from surface soil (0-5 cm) under *Larix leptolepis* forest (JA 874, 875).

Distribution. Japan (Gumma-ken and Tochigi-ken).

Remarks. The opisthosomal setae h_1 and ps_1 of the new subspecies are slightly swollen at the middle portion, taking an intermediate shape between those of *Palaeacarus hystricinus hystricinus* Trägårdh, 1932, and those of *Palaeacarus hystricinus kamenskii* (Zachvatkin, 1945), comb. nov. [= *P. kamenskii* (Zachvatkin, 1945)]; the setae seem variable in shape and they appear to be conical in some Japanese specimens. The solenidion on tarsus I is neither sickle-shaped (as in *P. hystricinus hystricinus*) nor straight (as in *P. hystricinus kamenskii*), its apical part weakly

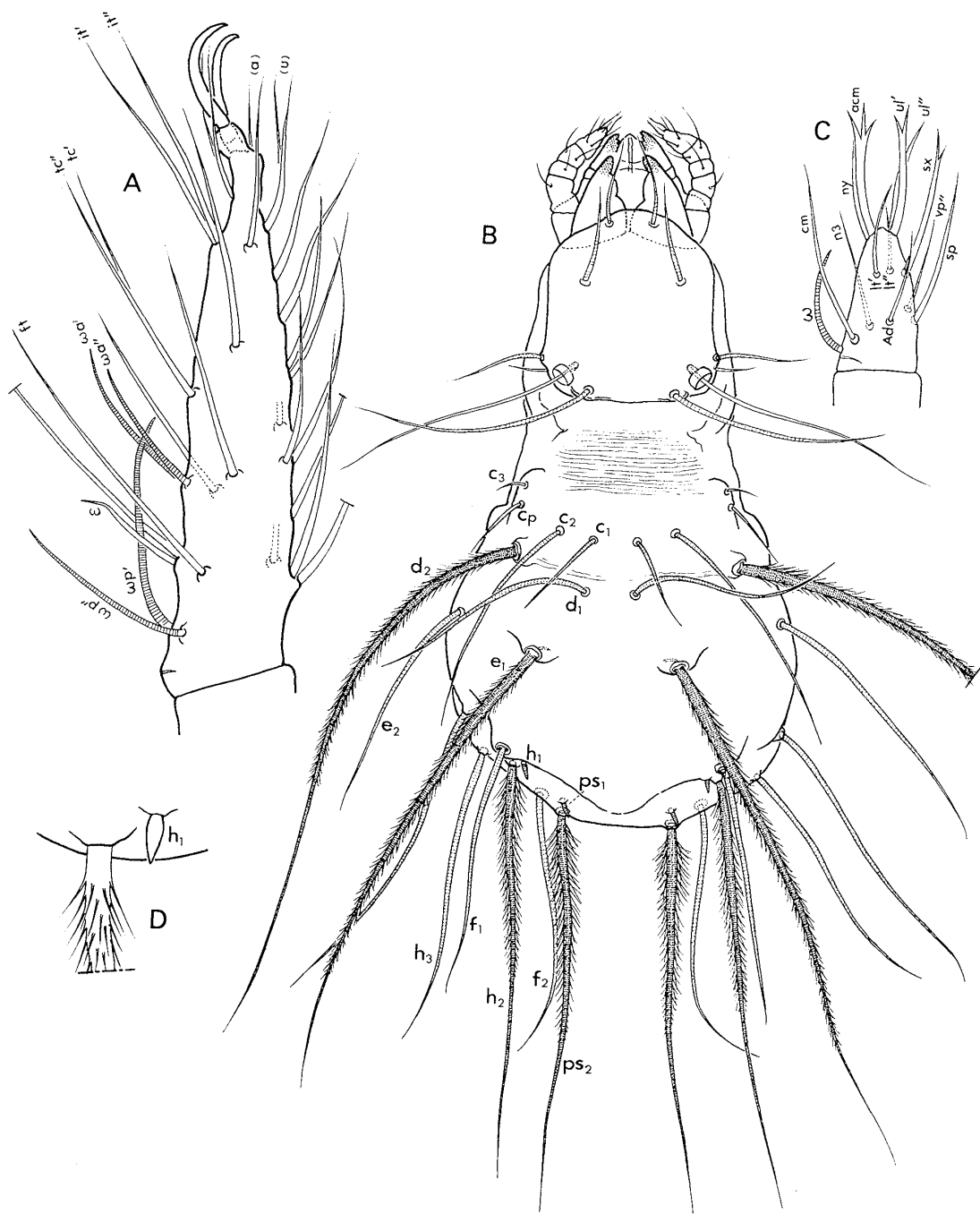


Fig. 2. *Palaeacarus hysricinus japonicus* subsp. nov. — A: Tarsus I. B: Dorsal. C: Palpal tarsus. D: Seta h_1 and basal part of seta h_2 .

bending toward posterior direction. The most peculiar feature of the new subspecies is the bifurcate ultimate setae (ul') of palpal tarsus; this condition is never found in the other subspecies.

Palaeacarus hystricinus Trägårdh previously recorded from Japan is considered to be the present new subspecies. — *P. hystricinus* from Hirugatake of Tanzawa (Aoki, 1964, p. 386), from Nikko (Aoki, 1975, p. 58), from Tokyo (Aoki, Ishikawa and Shiba, 1977, p. 99), from Musashi-Murayama (Ishikawa, Shiba and Aoki, 1977, p. 126), from Nashigahara of Mt. Fuji (Aoki, Ishikawa, Shiba and Harada, 1978, p. 146), from Aokigahara of Mt. Fuji (Aoki, 1968, Table 1) and from Oki Island (Harada and Aoki, 1978, p. 159).

Genus *Palaeacaroides* Lange, 1972

[Nise-mukashi-sasaradani Zoku]

Palaeacaroides Lange, 1972, p. 103; Bulanova-Zachvatkina *et al.*, 1975, p. 43.

Diagnosis. 1) Seta c_1 subequal in length to c_2 . 2) Of the opisthosomal setae, 3 pairs are strong, dark-colored and densely barbed. 3) Adanal seta ad_2 markedly longer than the remaining adanal setae, being more than $3\times$ as long as ad_1 .

Elementary chaetotaxy. ntg: (17+17); g: (9+9); ag: (3+3); an: (4+4); ad: (5+5). Bidactyle.

Type-species. *Palaeacaroides pacificus* Lange, 1972.

Distribution. USSR and Japan.

Palaeacaroides pacificus Lange, 1972

[Nise-mukashi-sasaradani]

(Fig. 3)

Palaeacaroides pacificus Lange, 1972, p. 103; Bulanova-Zachvatkina *et al.*, 1975, p. 43, fig. 23.

Measurement. Body length: 325–370 μ ; width: 165–190 μ . Lengths of body setae (on 1 ex.) (in μ): *ro* 45, *le* 40, *il* 105, *exa* 55, *exp* 14, c_1 95, c_2 90, c_3 14, c_p 40, d_1 130, d_2 225, e_1 220, e_2 130, f_1 8, f_2 128, h_1 125, h_2 11, h_3 115, ps_1 8, ps_2 107, ps_3 98, ps_4 29, an_1 30, an_2 23, an_3 20, an_4 20, ad_1 20, ad_2 73, ad_3 40, ad_4 35, ad_5 25.

Description. **Aspidosoma:** Posterior margin weakly arched and lateral margins almost parallel. Rostrum only weakly projecting. Rostral setae twice as long as their mutual distance. Lamellar setae slightly shorter than *ro*, being subequal in length to their mutual distance. Interlamellar setae more than twice as long as *ro*. Anterior exobothridial seta (*exa*) longer than *ro*, about $4\times$ as long as posterior exobothridial seta (*exp*). Sensillus whip-like, slightly longer than *il*. **Opisthosoma:** Setae d_2 , e_1 and ps_2 densely barbed, while the remaining setae are glabrous; setae c_1 and c_2 subequal in length, c_2 being inserted closer to c_1 than to c_3 ; seta c_p a half as long as c_2 and $3\times$ as long as c_3 ; $d_1=e_2$; $d_2=e_1$; f_1 , h_2 and ps_3 very short, shorter than c_3 ; $f_2=h_1>ps_3>ps_4$; setae ps_2 weakly swollen near the base. **Genito-anal region:** Genital plate with 9 setae. Three aggenital setae located laterally of the posterior half of genital opening. Anal plate with 4 setae, which become progressively shorter from an_1 to an_4 . Adanal plate with 5 setae, of which

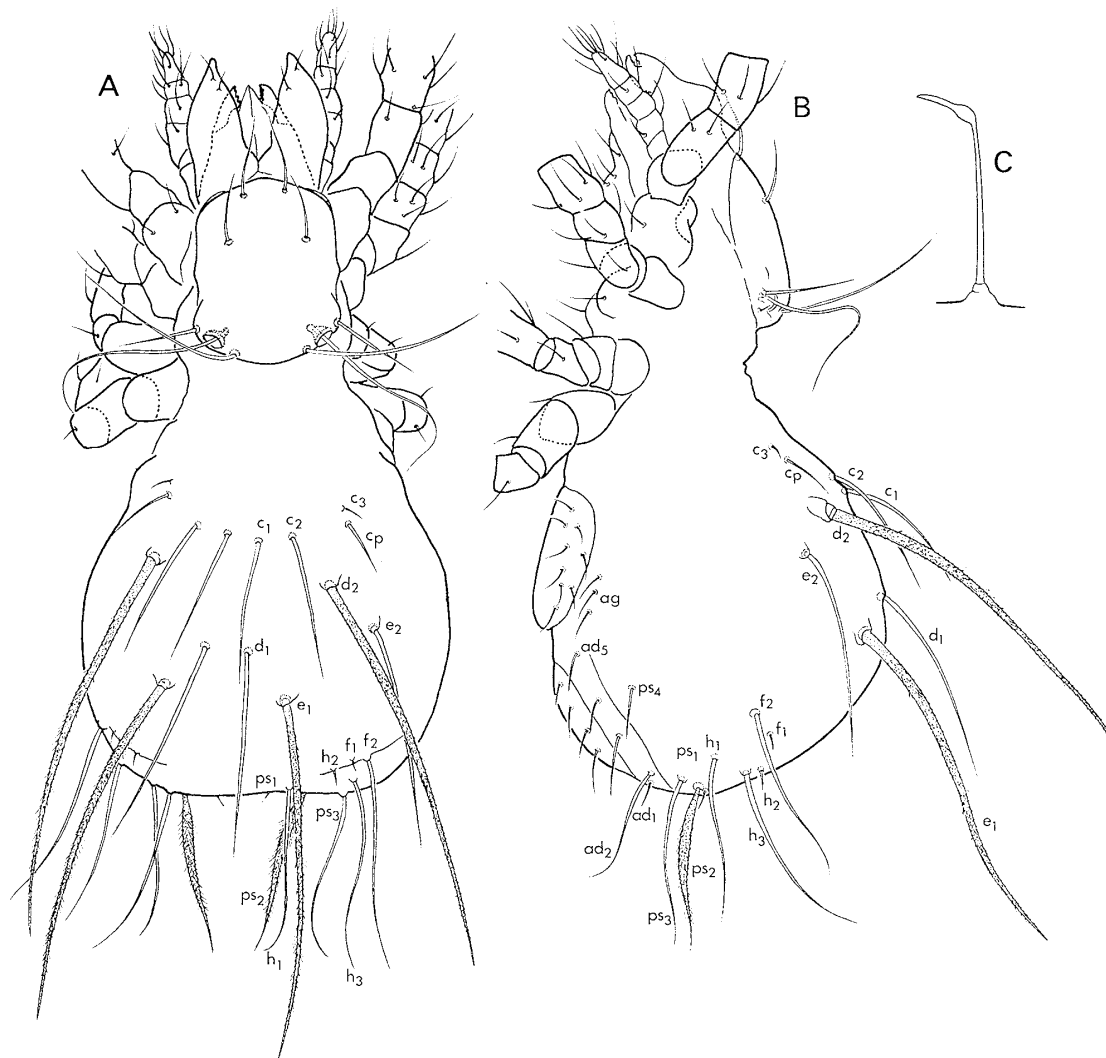


Fig. 3. *Palaeacaroides pacificus* Lange, 1972. — A: Dorsal. B: Lateral. C: Famulus on tarsus I.

ad_2 is markedly longer and thicker than the remainder; $ad_2 > ad_3 > ad_4 > ad_5 > ad_1$. Legs: Claws on tarsus I distinctly larger than those on tarsi II–IV. The proximal solenidion on tarsus I decumbent. Famulus long and erect, with a bending apex which is swollen and then narrowed at tip.

Collecting data. 2 exs., Hikage-tunnel, Katsunuma-shi, Yamanashi-ken, 7–XII–1976, J. Aoki & H. Harada, from surface soil (0–5 cm) under *Quercus serrata* (JA 2296); 1 ex., E of Sasago, Otsuki-shi, Yamanashi-ken, 7–XII–1976, J. Aoki & H. Harada, from litter under *Pinus densiflora* (QM 221).

Distribution. USSR and Japan.

Remarks. The species previously recorded from the following localities as *Palaeacarus* sp. A is considered to be identical with *Palaeacaroides pacificus*. —

Meiji-jingu in Tokyo (Aoki, Ishikawa and Shiba, 1977, p. 99) and Musashi-Murayama (Ishikawa, Shiba and Aoki, 1977, p. 126).

Family Ctenacaridae Grandjean, 1954

[Shiriken-dani Ka]

Genus *Ctenacarus* Grandjean, 1939

[Shiriken-dani Zoku]

Ctenacarus Grandjean, 1939, p. 543.

Grandjeanacarus Zachvatkin, 1945, pp. 673–676.

Diagnosis. 1) Opisthosomal setae contain 2 pairs of long, strong and dark-colored setae and 1 pair of hind peculiar setae which are leaf-shaped or provided with long barbs. 2) Seta c_1 always shorter than c_2 .

Elementary chaetotaxy. ntg: (20+20)~(23+23); g: (9+9) or (10+10); ag: (3+3)~(8+8); an: (5+5)~(7+7); ad: (5+5)~(8+8). Tridactyle.

Type-species. *Palaeacarus araneola* Grandjean, 1932.

Distribution. Morocco, Algeria, Brasil and Japan.

Ctenacarus araneola (Grandjean, 1932)

[Shiriken-dani]

(Fig. 4)

Palaeacarus araneola Grandjean, 1932, p. 417, figs. 5–7.

Ctenacarus araneola: Grandjean, 1939, p. 543; 1954, p. 248, figs. 22–25; Schubart, 1968, p. 254, figs. 25–26; Aoki, 1979, p. 63, figs. 2-F, G and H (photos).

Grandjeanacarus araneola: Zachvatkin, 1945, p. 673–676.

Diagnosis. 1) Sensillus has an weakly thickened portion. 2) Seta *fe* leaf-like. 3) Setae d_2 and e_1 glabrous.

Measurement. Body length: 330–425 μ ; width: 150–193 μ .

Elementary chaetotaxy (Japanese material). ntg: (20+22) or (22+23); g: (10+10) or (11+9); ag: (6+6); an: (6+6) or (7+6); ad: (6+6) or (8+7). Epimeral setae: 4–3–4–4. Tridactyle.

Description. Aspidosoma. Tip of rostrum forms a triangular projection, which is sometimes invisible from above because of its downward inclination (Fig. 4-A). Rostral setae inserted close together, being weakly bent downward and inward (the specimen from Yoro-jima Is. is deficient in the left rostral seta, even its insertion pore being undetectable). Lamellar setae slightly longer than rostrals; they are widely separated from each other, the mutual distance being wider than that of interlamellar setae. Interlamellar setae nearly straight, $1.8 \sim 2.0 \times$ as long as rostral setae. Anterior exobothridial seta nearly similar in length to *ro* or *le*, almost twice as long as posterior exobothridial seta. All the prodorsal setae without barbation. Sensillus subequal in length to interlamellar seta, being weakly thickened

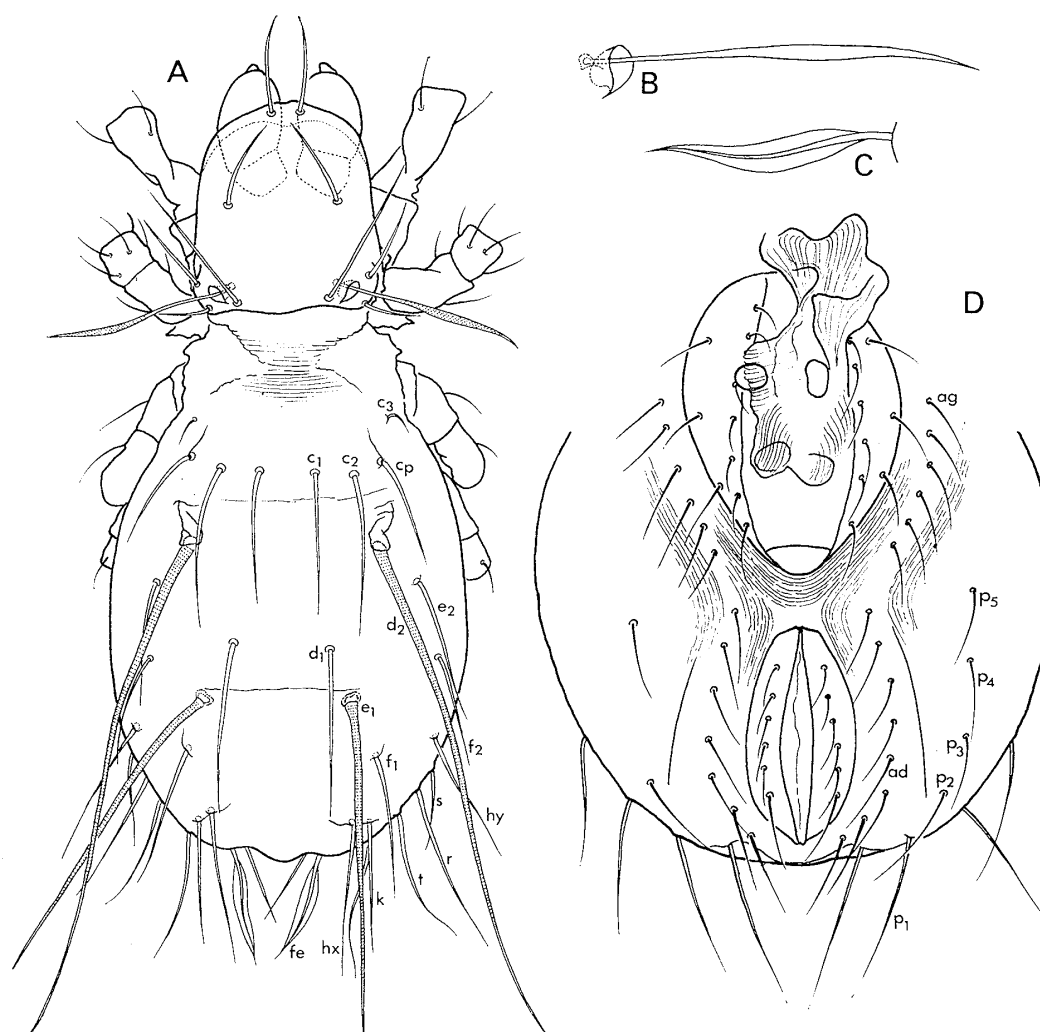


Fig. 4. *Ctenacarus araneola* (Grandjean, 1932). — A: Dorsal. B: Sensillus. C: Opisthosomal seta *fe*. D: Ventral side of opisthosoma.

Table 1
Variation in the number of setae in *Ctenacarus araneola* (Grandjean).

	Grandjean's material	Japanese material	
		Yoro-jima Is.	Minami-Daito Is.
Rostral setae	1+1	0+1	1+1
Genital setae	10+11	10+10	11+9, ?+10
Aggenital setae	8+8, 7+7	6+6	6+6, ?+7
Anal setae	7+7, 6+6	6+6	7+6, ?+7
Adanal setae	8+7, 6+6	8+7	6+6, ?+7
Setae of p-series	7+7	6+3	3+5

at the middle~subapical portion, which is dark in color. Opisthosoma. Setae c_1 , c_2 and c_p arranged in a transverse line; length of $c_2 > c_1 > c_p$; $c_2/c_1 = 1.08 \sim 1.14$; distance $c_1 - c_1 > c_1 - c_2$; c_3 short, about 1/5 as long as c_2 . Setae d_2 and e_1 distinctly thicker and longer than the remaining notogastral setae; they have dense, transverse striae and are darker in color than the others; d_2 $1.4 \sim 1.5 \times$ as long as e_1 . A weak transverse line found between insertions of e_1 . A pair of posterior setae, fe , foliate, having a median rib and hyaline membranous structures on both sides. Setae of p -series variable in number; (3+5) in a specimen from Minami-Daito Is. and (6+3) in a specimen from Yoro-jima Is. The order in length of notogastral setae: $d_2 > e_1 > d_1 = c_2 > c_1 > f_1 = e_2$, $f_2 = f_6 = c_p > c_3$. Genito-anal region. Genital plate with 9–11 setae arranged in 2 longitudinal rows. Six aggenital setae arranged in a straight line. Anal plate with 6 or 7 setae, which become progressively longer toward the posterior direction. The number of adanal setae variable from 6 to 8; ad_1 and ad_2 appear to be somewhat thicker than the remainder.

Collecting data in Japan. 1 ex., Yoro-jima Island of Amami Shoto, S. Japan 3–II–1972, H. Suzuki, from nests of a sea bird; 3 exs., Kita-mura of Minami-Daito-jima Island, S. Japan, 8–X–1978, J. Aoki, from litter under the forest of *Livistona chinensis* var. *subglobosa*.

Distribution. Morocco, Algeria, Brasil and S. Japan.

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